

# Uncertainty in Estimating Human Behavior

By Sameul R. Dick

**Editorial Abstract:** *The author explores the challenges of analyzing complex systems, contrasting human behavior models with those of hurricane predictions. He describes how better understanding of predictive tools may enhance DOD leaders' relative confidence levels.*

After more than a decade of public discussion about Information Warfare, Information Operations, Net-Centric Warfare and the ongoing Revolution in Military Affairs, a widespread belief has developed within the Department of Defense regarding the changing environment our military experiences, and the US's ability to engage adversaries within this new environment. The Oct 2003 DOD *Information Operations Roadmap*, with its 57 recommendations and the subsequent programming of resources to act on those recommendations, showed a clear recognition of a DOD need. The formidable military capabilities deployed at the end of the last century must adapt to the burgeoning information age that marks the beginning of this new century.

As we reached the end of the first fiscal budget (FY 06) year directly influenced by the watershed *IO Roadmap*, another widespread belief emerged. A growing understanding of the importance of influencing human audiences has led to some frustration concerning our inability to anticipate human audience behaviors. This frustration manifests itself in the belief it is not possible to 'predict' human behaviors. The frustration felt by DOD decision makers is well founded, and reflects a private sector concern for marketing and public relations of products. In part, this frustration is due to different expectations of what a 'prediction' really provides a decision maker. Reviewing another area of science where 'predictions' are important may point to potential tools to aid those employing military capabilities to influence human audiences and their behaviors.

When DOD members express their frustration over 'prediction' capabilities for human behaviors, they are not alone. Within the marketing and public relations industries, there is an underlying concern over the ability to anticipate the targeted human audience (market, in their viewpoint) and the market's changing behaviors. Some of this concern is expressed in the dramatic drop in estimated spending on advertising during 2006 (approx \$615B, down from nearly \$1T in 2005). Changes in how those market audiences engage their information environment combine with the industry's basic concern over how much impact their advertising dollars will generate—and results in a much lower estimated investment for 2007.

Some of the cause for frustration among decision makers comes from their expectation of what 'predicting' means when applied to human behaviors. Exact behaviors are difficult to elicit from people for many reasons. But experience with the application of military capabilities has left many DOD decision makers with the impression that predictions come true, mostly. Thanks to decades of developing Joint Munitions Effects Manuals, force-on-force Lancasterian conflict models, and the standardization of planning processes around the JOPES (to



Figure 1. 28 Aug 06 track predictions.  
(National Hurricane Center)

mention just a few innovations), DOD decision makers have come to expect highly developed, well supported estimates of outcomes. Confidence levels for these estimates have become fairly robust. When a DOD leader hears a speaker say 'predict human behavior,' the comparison of those robust confidence levels versus less robust efforts to estimate human elements, immediately leads the DOD leader to conclude 'it's not possible to predict human behavior.'

Despite this tendency in some areas of 'prediction,' DOD decision makers have become comfortable with relatively lower levels of confidence. One of the most historically important areas is the impact of weather on combat operations. Weather 'prediction' is notoriously inaccurate, yet the DOD spends significant effort to determine the current state, and estimate the future weather. Decision makers have come to understand that in weather prediction, confidence in estimated outcome is high for only a short time—or over a large area—and quickly becomes out-of-date.

Hurricane modeling and track prediction may provide a useful analogy of a potential technique for estimating similarly complex and chaotic human audience behavior. Both of these systems are highly dynamic, and individual models rarely accurately predict future behavior. However, the aggregation of several well-correlated estimates provides actionable information to guide decision makers in making evacuation choices, and positioning emergency response forces. Similarly, analysts could aggregate estimates of human audience behavior, improving confidence to a level valuable to military decision makers planning to influence those behaviors.

To provide better understanding of the potential application of an analogous human audience behavior estimate, it is useful to look at the details of the hurricane track estimating process. Forecasters update the models every 6 hours (during an active storm) with the best measurements available, and make projections as far into the future as their confidence levels

# Hurricane Ernesto Operational Models 08/28/2006 12UTC

Created by Bryan Woods, TheStormTrack.com

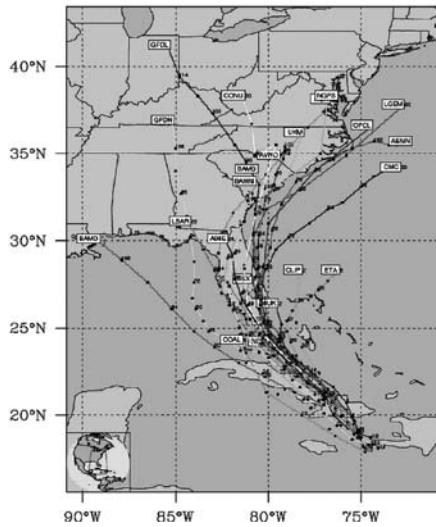


Figure 2. Detailed model estimates. (NOAA/National Weather Service)

allow. Figure 1 shows the several models of the ‘spaghetti plot’ that is produced by hurricane forecasters (Hurricane Ernesto, Aug-Sep 06). This portrayal of the hurricane track prediction system is rarely noted in public.

The actual NOAA predictions for this date in Aug 06 (Figure 2) show detail for each of the several predictive models used in preparing the track forecast.

Both the public and decision makers primarily use a generalized hurricane track estimate derived from contributions of various models (Figure 3, same date). This aggregation of the individual models recognizes the inaccuracy of the individual predictions, but increases the confidence level of the overall track estimate, rather than rely on any single prediction. It shows likely left and right bounds and traces a ‘most likely’ future track, based on the aggregation of the individual model predictions.

The actual track three days later shows that although the estimates were largely wrong (some of the individual models came close), the

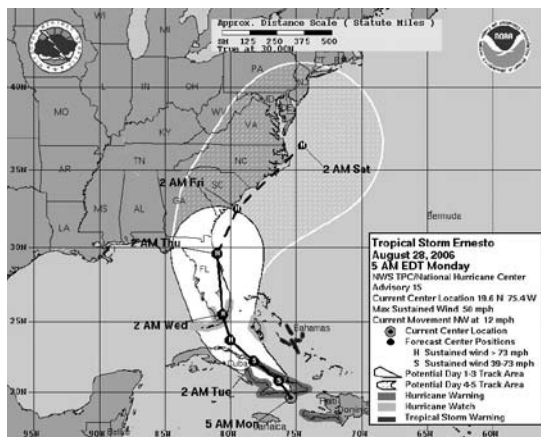


Figure 3. Track prediction with fan and centerline. (NOAA/NWS)



Figure 4. Actual track. (NOAA/NWS)

overall track was within the predicted ‘fan’ of the expected track and therefore provided useful evacuation warning and recovery forces staging (Figure 4).

The correlation of any individual hurricane track models to the actual track may be relatively high for one storm, but the same model may show comparatively low correlation for the next storm. These differences reflect the ‘state of the art’ in forecasting storm tracks. Despite the lack of consistency of the individual predictive models, the NOAA approach to storm track estimating provides a valuable illustration of how mathematically complex and chaotic system behaviors can be portrayed in ways that are valuable to decision makers.

While the difficulties in providing individual track predictions for a targeted human audience may still be difficult, using an aggregated estimate can optimize the confidence level for DOD decision makers. Navigating the landscape of human behaviors may be fraught with error, but navigating them without a map showing the likely outcomes may be the largest error. Owing to their complex nature, exact ‘prediction’ may never be possible for human behaviors. Adjusting to an estimate of behavior tracks may provide the best available tool. 🌀